

Small scale heat exchanger test operating procedure
08/19/99

Goal:

Investigation for the thermal behavior of the LHC IR heat exchanger sample

How:

The thermal behavior will be known by measuring the total resistance R_t through the copper corrugated wall ($R_t = 2 * R_{kapitza} + 1 R_{cu}$) thus by measuring the temperature difference ($T_1 - T_3$) (see Figure1).

What:

Reading: the sensors are 3 thermometers (2 inside (T_1 , T_2) and 1 outside (T_3)), 2 pressure transducers (PT_1 , PT_2), 1 heater (H) and 3 level indicators (LT_1 , LT_2 , L_{tpoint}).

Control: the bath pressure in the saturated He II in test dewar.

Measurements annex

- The thermometers will be re-calibrated several points in HeII temperature range against helium vapor pressure.
- Calibration of the flow meter (SCFH) with helium gas at atmospheric pressure.

Operating procedure of the set-up

Training of the set-up:

1. Check all sensors, at room temperature, once the test rig is inside the dewar, measure electric resistance of all sensors from the rack system. Compare these results with the previously measured values.
2. The valve V_1 , which connecting the corrugated can and bath, should be open before transferring liquid helium.
3. Purge the whole system 3 times: pumping the dewar to vacuum (around $1E-3$ mbar), then fill the system with GHe to atmospheric pressure and relieve the GHe to the atmosphere. Repeat the procedure 3 times.

First cool-down:

4. Transferring slowly the LHe to the test dewar. V_3 and V_2 are close, V_1 open. For the first time transfer, the transfer line can be insert directly into the dewar when GHe comes out of the transfer line. (One opening port

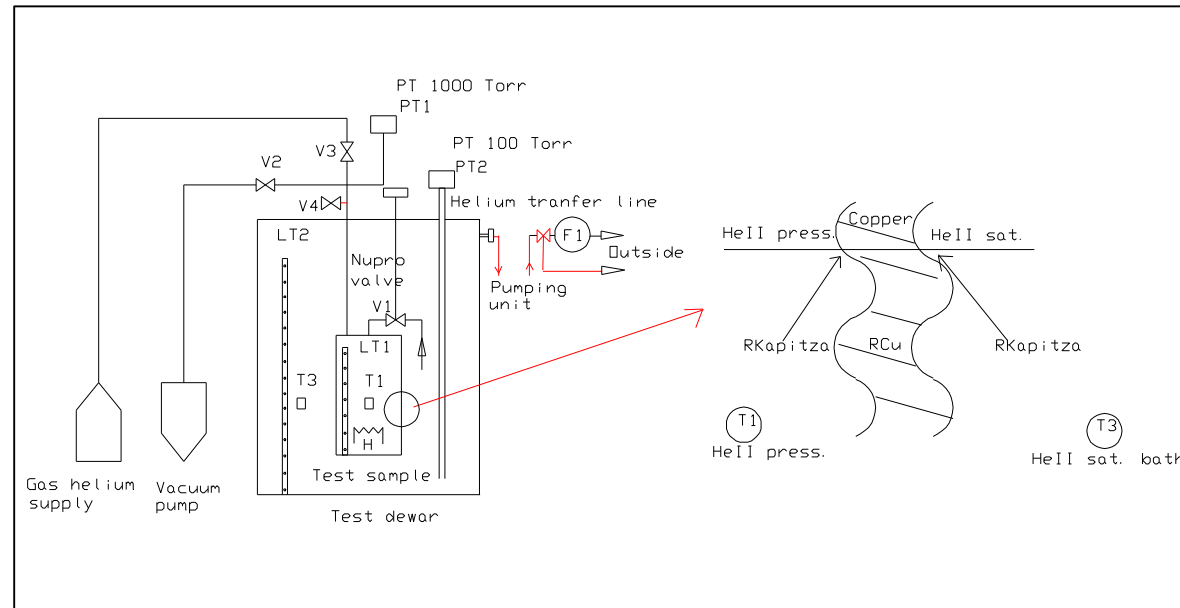


Figure 1. : scheme of the system

Steady State:

Hypothesis to check and control during all steady state measurements:

7. The temperature T_3 of the saturated bath should be stable (controlled by the bath pressure PT_2). The GHe cylinder will be used to keep the container around one atmospheric pressure (controlled by V_3 and the pumping unit).
8. The flow-meter, F_1 is used to measure the boil-off of GHe at room temperature so that the heat leak from surroundings (sources different from the Hx: parasitical sources) can be measured.
9. The bath helium level (LT_2) should remain 4 " above the top of the corrugated sample, during the operation.
10. All power supplies should deliver a constant power.
11. Investigation on parameter variations: T_3 , Q_{elec} (H), PT_2 will be changed, step by step.
12. A venting valve (small relief valve) V_4 is needed for the space of corrugated sample. This valve is needed for the system warming up.
13. The maximum ΔT expected is 100 mK (correspond to $T_3 < 2.17$ K).

Measurements scenario

Nominal conditions: $T_3 = 1.80$ K

14. Several data points will be taken with no electrical load, Q_{elec} , in order to measure the time constant for the stability of the system with time. . (See acquisition process for frequency and recorded time.)
15. Measurement of the heat load by mean of the boil-off method (measurement of the He flow). $Q_{elec} = 0$ Watt.
16. Calibration of the heat exchanger: Increase the electrical power by step of 1 watt. For each step, wait the stabilization of T_3 and make an acquisition of the temperatures as well as a measurement by the boil-off method. Then add 1 watt and repeat the measurements up to 10 watt.